Research Online Publishing
www.ronpub.com

Open Access

Open Journal of Cloud Computing (OJCC)
Volume 1, Issue 1, 2014

www.ronpub.com/ojcc
ISSN 2199-1987

Measuring and analyzing German and Spanish customer satisfaction of using the iPhone 4S Mobile Cloud service

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Abstract

This paper presents the customer satisfaction analysis for measuring popularity in the Mobile Cloud, which is an emerging area in the Cloud and Big Data Computing. Organizational Sustainability Modeling (OSM) is the proposed method used in this research. The twelve-month of German and Spanish consumer data are used for the analysis to investigate the return and risk status associated with the ratings of customer satisfaction in the iPhone 4S Mobile Cloud services. Results show that there is a decline in the satisfaction ratings in Germany and Spain due to economic downturn and competitions in the market, which support our hypothesis. Key outputs have been explained and they confirm that all analysis and interpretations fulfill the criteria for OSM. The use of statistical and visualization method proposed by OSM can expose unexploited data and allows the stakeholders to understand the status of return and risk of their Cloud strategies easier than the use of other data analysis.

Type of Paper and Keywords

Short communication: *Organizational Sustainability Modeling (OSM; Mobile Cloud services; customer satisfaction ratings in Mobile Cloud and iPhone 4S; relationship between economic downturn and rate of customer satisfaction in Mobile Cloud service;* special issue from *the first international workshop on Emerging Software as a Service*

1 Introduction

Cloud Computing provides added value for organizations; saving costs in operations, resources and staff – as well as new business opportunities for service-oriented models [3], [11], [14]. There are applications and services in emerging areas which have increased demands and are worth to explore. One such area is Mobile Cloud. Current literature has emphasized in the system design, development and deployment examples [7], [9]. There are few literatures about the surveys focusing on the customers and their rating of satisfaction towards using Mobile Cloud services. It is important and useful to understand consumer behaviors and preferences for mobile products and services. In order to define what to measure, propose how to measure and analyze data, a systematic method is required. A proposed method can systematically compute all these data and explain the interpretations of these data, in the form of statistical modeling or visualization. Reporting the status of risk and return of such Cloud adoption is important, since it can provide stakeholders an overview about their service rating, risk monitoring and analysis of their strategies, such as whether their Cloud services have met their expected targets. In this way, the businesses can be more adaptable to the fast-paced requirement changes for Cloud Computing, particularly Mobile Cloud, which is a fast-growing area.

To address the requirements and challenges described in the last paragraph, Organizational Sustainability Modeling (OSM) is designed to measure and calculate risk and return status for adopting Cloud Computing. This is designed to process and analyze big datasets and complete computation of results within seconds. It can provide explanations of the key statistics and interpret them in a way that makes the stakeholders to understand the status of their risk and return of Cloud adoption at regular periods. In summary, two advantages are available for using OSM: (i) it computes the status of risk and return of Cloud adoption; (ii) the use of visualization technique can simplify about the understanding of complex datasets and (ii) results provide empirical evidences to critically evaluate about the Cloud strategy and recommendations towards their return and risk status. The structure of this paper is as follows. Section 2 introduces OSM and explains how it can be used. Section 3 describes the data analysis process and presents the results and their interpretations for German data and Section 4 explains results of Spanish data. Section 5 describes two topics for discussion and Section 6 sums up agenda and analysis of results for this paper.

2 ORGANIZATIONAL SUSTAINABILITY MODELING

Organizational Sustainability Modeling (OSM) is improved version based on the CAPM which is the analysis of return and risks for organizations or projects. Chang et al. [1], [2] demonstrate how OSM can be used to measure risk and return status for SAP, Vodafone/Apple and two projects in National Health Services, UK. The proposed approach is to divide return and risk in three areas: Technical, Costs (Financial) and Users (or clients) before and after deploying cloud solutions or products/services. In some context, it can be defined as expected return and actual return. The data to be collected are dependent on organizational focus. In this paper, the focus is on users investigating the popularity in using iPhone 4S and their services for a twelve-month period. This keeps stakeholders informed of the consumers and market requirements, which can be fast-paced and competitive in the Mobile Cloud industry.

The use of OSM has a track record of analyzing risk and return status for Cloud adoption, which include detailed analysis for profitability and risks for Vodafone with iPhone and iPad strategies [2], [3]. This includes advanced statistical computing and the innovative approach of presentation of complex data analysis in 3D Visualization, which offers two benefits:

- Results in statistical computing are not presented in visualization. It consolidates the quality of analysis by offering a different perspective of data processing.
- Anyone without prior backgrounds can find analysis easier to understand without going through the interpretation of statistical results. Visualization presents three key metrics. This is useful for stakeholders.

In Chang et al. [2], [3] statistical and visualization analysis, Apple iPhone and iPad have offered Vodafone between 22% and 26% of extra profits between 2009 and 2010. This means Vodafone has adopted the right strategies of using iPhone and iPad to increase their profits and market dominance.

2.1 Organizational Sustainability Modeling

OSM is the improved model based on Capital Asset Pricing Model (CAPM) [1], [2], [4], which has three major limitations. First, it does not support large data processing since it was originally designed in 1960s and large data processing is a requirement for Big Science. Second, it is a generic model for risk and return analysis and additional work is required to make it suitable for system adoption. Third, the risk-free rate does not exist in reality most of times. Additional work is required to define how to control risk and monitor the changes in the risk-control rate. Based on these requirements, the OSM formula is presented as

$$e = r_c + \left(\beta(a - r_c)\right) \quad (1)$$

where a is the actual return (or performance) of a large computing systems project or investment. r_c is the risk control rate. It can be interpreted as the rate that is free of risk, or the rate that risk can be managed. This is the rate for manageable risk. e is the expected return (or performance) of a large computing systems project or investment, and β is the beta value to represent risk measure or uncontrolled risk. These are unpredictable events which cannot be managed and have a direct impact on the adoption of the system.

The uncontrolled risk, beta, can be calculated once when the expected value, the actual value and risk-control rate in each dataset are available. A good approach is to calculate all beta values and average them out. Another approach for calculating beta is to perform linear regression, where the gradient of the slope is the value for beta [4], [12]. So the formula becomes

$$\beta = \frac{e - r_c}{a - r_c} \quad (2)$$

The steps above require the following input:

- Actual return values (a): the actual values obtained from the measurement.
- Expected return values (e): using the previous data (or previous measurement) as the benchmark, or using computation technique to model the expected values.
- Risk-control rate (r_c): the percentage that does not affect risk if targets are not met. It is often managed and controlled under 5% [4].

After collecting at least several hundred of metrics, these data can use OSM to calculate beta, and compute the overall risk and return values to present to stakeholders.

2.2 A generic hypothesis

In regard to discussion in introduction about the relationship between the Mobile Cloud Service and, results in our previous papers [2], [3], [6] also demonstrate the direct relationship between the user satisfaction and the economic downturn or the business performance of the invested company. In our previous workshop paper [6], results support the case that the customer satisfaction is related to the economic downturn. In other words, the customer satisfaction is influenced by a country's economy. Our rationale from that data analysis is that if the country is in economic crisis and customers have either receive less pay or at the risk of losing their jobs, they feel that Mobile service may cost them more than the necessity in life such food and accommodation. Based on the observations in our previous studies and the analysis of German data, we propose the first hypothesis:

H 1. The rate of customer satisfaction in Mobile Cloud Services can reflect the recovery on economy

The results in this section will justify whether our hypothesis can be validated.

2.3 Motivation for iPhone 4S, a representation of Mobile Cloud

Chang et al [2] presented their Vodafone/Apple case study on Mobile Cloud and it had an overall coverage of iPhone and iPad models. The generalization provides useful recommendation for potential and current investors [3]. Based on our knowledge from investors' requirements, they feel analysis will be more useful if it can be focused on each specific model. This may include iPhone 4S model alone and its computational analysis about its business performance. We assert that the integrated approach has the following advantages:

- It is cost-effective and can provide data and results in the minimum amount of spending.
- The quality of analysis is at a high level of standard, since it goes through a series of quality assurance (QA) process.

The OSM approach can ensure a high quality of analysis and a low cost spending can be achieved. This can ensure a higher return status for investors. In addition, market contests between smart phones, mobile clouds, service providers and mobile applications for Clouds have become more competitive than before and it is useful to keep track of market demands and consumer requirements so that our Cloud strategies and recommendation can be kept up-to-date.

3 DATA ANALYSIS: THE RATIONAL AND THE PROCESS INVOLVED

This section describes the computational analysis of the collected datasets and explains the interpretations from the data. The source of data is from Kantar Worldpanel ComTech [8], a market research company, as well as Anastaya, a consulting firm specializing in data analysis. The author worked in Anastaya for a period of time as a part-time consultant. A thorough data analysis approach has been adopted to ensure data analysis can be unbiased and reflect the actual risk and return status of the mobile cloud adoption. The objective of this research is to analyze the rate of customer satisfaction and the rate of adoption in the EU zone such as Germany and Spain.

Although Kantar Worldpanel ComTech has published a report on the iPhone 4S performance in EU, it does not provide detailed statistical and computational analysis. It only offers an estimated percentage of performance downgrade and does not provide any detailed analysis. Therefore, we aim to provide a more comprehensive analysis with the following objectives:

- Compute the exact extent of performance downgrade (or improvement) in EU countries. In this paper, we focus on the German data because Germany is a country behind Euro backing and is a good reflection on how top-tier EU country performed in the economic crisis. We also present Spanish data because Spain was hit by the economic crisis for some time.
- To provide a rationale and analysis about their performance (downgrade) based on our results.

3.1 OSM metrics and data processing overview

The use of OSM metrics is as follows.

1. The expected values included the 2010 to 2011 data taken a year before the study began. The actual values included the 2011 data, to investigate the usage of mobile cloud adoption in 2012.
2. The risk data between 2011 and 2012 was collected by Kantar Worldpanel ComTech. It was measured based on the percentage of dissatisfied users (although they were dissatisfied, they still used iPhone 4S services. This was a risk-control rate – if Apple could offer better and cheaper deals, users would be happy to stay on based on their feedback) measured in six German cities were chosen for customer satisfaction survey: Berlin, Hamburg, Munich, Frankfurt, Dresden and Hannover.

Datasets follow the requirements of the OSM formula (2). Each row of data contains the numerical values for the actual value, expected value and risk-control rate of the German Mobile customer usage. Each row of datasets contains the actual and expected values of measurement, and risk-control rate associated with each pair of actual and expected values. The data processing takes each row of datasets – reading all data values; putting data values into the formulas; and then perform statistical regression while using OSM. Another code algorithm is required for statistical analysis after the data processing from first round of OSM analysis. Statistical programs have two steps.

- The first step is to calculate the generic statistics including mean, standard error, p-value, t-value and R-squared value.
- The second step is to compute advanced features such as Durbin-Watson test, Sum of Squares Error (SSE) and Mean Square Error (MSE).

The statistical program is written in SAS, a statistical software and language for analysis. Ordinary Least Square (OLS) is useful to compute regression modeling for linear model such as OSM, and is used for statistical program for data analysis. All numerical data for actual and expected values and risk-control rate can be computed based on the code algorithm [4].

3.2 OSM data analysis

This section presents results of the German data analysis and explains the interpretations of all these key statistical values. All the data is based on between January 2011 till December 2011, which provides twelve months of period of popularity measurement for iPhone 4S. OSM can be modeled by statistical languages, in which SAS is more suitable than other languages since it can compute more in-depth analysis [1], [2]. The data is carefully calculated, examined and randomized. Twelve months of data for this case study is sufficient to analyze its business performance, since this is a model specific approach and often Apple product/service performance can be determined within the first few months in the market release [8]. SAS program for OSM is coded for computation and explained in our previous studies [1], [2].

Computational modeling of OSM will use a, e, r_c as the input to compute risk. The output should contain the following:

1. Beta (β) is a value to determine the risk measure (or the extent of the volatility), which is the uncontrolled risk that may affect the Mobile Cloud popularity.
2. Standard Error (SE) of the mean is the range of the mean that the experimental results fall into for OSM. The smaller the standard error, the smaller the difference between expected and actual return values [10].
3. Durbin-Watson (DW) is a test used to detect the presence of autocorrelation (a relationship between values separated from each other by a given time lag) in the residuals (prediction errors) from a regression analysis. The result of

Durbin-Watson (DW) should be above 1 [10]. Durbin-Watson is used to test regression computed by OSM and accuracy of the output, and also the statistical behaviors. The value for Pr > DW corresponds to the negative autocorrelation test (residuals eventually wither off) and is a preferred method in the OSM approach, and the value of Pr > DW should ideally get as close as to 1 to reflect the accuracy of the OSM regression. The p-value used by most of statistics is the positive autocorrelation value and can be worked out by subtracting the value of Pr > DW by 1. See Table 1 for results.

4. Mean Square Error (MSE) is an estimator to quantify the difference between estimated and actual values. A low MSE value means there is a high correlation between actual and expected return values.

5. R-squared value is used to determine how the regression fits in a line. Both 95 and 99.99 Confidence intervals (CI) are computed. In this context, it is referred as "R-squared value for firm", a term that is commonly used in econometrics to describe the percentage of risks in proportion to the external or internal organizations or factors [10]. If an organization has an R-squared value (99.99 C.I) of 0.3, this means 30% of risks are from external bodies or the market and 70% of risks come from the organization such as poor adoption decision, overspending, poor selection of equipment (resulting in accidents).

The results for OSM regression is as follows.

Table 1: OSM key statistics for German data in Mobile Cloud analysis

Beta 54.46% of risks: external and 45.44% of risks: internal	0.5345	**Durbin-Watson** Pr>DW (negative autocorrelation: maximum of 1) Positive autocorrelation (p-value)	1.7068 0.9130 0.0870
Standard Error	0.1447	Regress R-Square (99.99 C.I)	0.7107
Mean Square Error (MSE)	0.15369	Regress R-Square (95 C.I)	0.5456

Further explanations are presented as follows.

- Beta is equal to 0.5345. The medium-low value suggests the project risk is maintained at a good control rate.
- Standard error is 0.1447. The low value suggests most metrics are close to each other and the data has fewer extremes. There is a high consistency between all metrics.
- The first order Durbin-Watson: Pr > DW is the p-value for testing negative auto-correlation which favors OSM. Results show that there is a high negative auto-correlation (0.9130), which is close to 1 in favor of OSM and also has an acceptable quality of data and standard errors. The p-value is the positive autocorrelation and is equal to 0.0870.
- The low Mean Square Error (MSE) value suggests a good consistency between actual and expected return values.
- Main regression R-square is 0.5456. It means 54.56% of the risks are from the externals such as funders' cost-saving plans and 45.44% of the risks are from the internals, which include the higher line rental prices or services not improved over 12 months.

3.3 3D Visualization for German data

The next stage is to convert all datasets into 3D visualization. The rationale is that results in visualization can expose unexploited data and help stakeholders without prior data knowledge can interpret the analysis more easily. Chang et al. [1], [2], [5] also demonstrate 3D Visualization is a simplified analysis for stakeholders to understand and then to make the appropriate actions based on analysis. Mathematica allows data conversion and presents it in a visual format. Data is then computed in Mathematica and the 3D visualization models are presented in Figure 1.

Figure 1 is the 3D Visualization for iPhone 4S user satisfaction in Germany. The x-axis shows actual iPhone satisfaction rating is between -4.3 to -5.8%, and the y-axis shows expected iPhone satisfaction rating is between -3.0 to -4.0% and z-axis presents risk-control rate in the market is between 1.0 and 1.8%. The EU market has an economic downturn, which is expected to impact sales and popularity, but the actual performance is lower than the expected performance. This may mean iPhone 4S has tough competitions from other models with Android systems. These models tend to offer lower prices than iPhone models and have become more competitive in economic downturn [13].

- x-axis: Actual iPhone satisfaction rating (-4.3 to -5.8%)
- y-axis: Expected iPhone satisfaction rating (-3.0 to -4.0%)
- z-axis: Risk-free rate in market (1.0-1.8%)

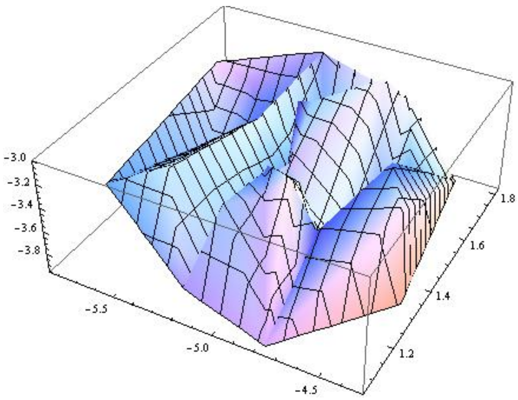

Figure 1: iPhone 4S user satisfaction in Germany between January and December 2011

4 THE ANALYSIS OF SPANISH DATA

Spain has been under the threat of European financial crisis for some time. The purpose of this case study is to identify any direct relationship between the macroeconomic performance and consumer spending as reflected in the rating of customer satisfaction. As identified in hypothesis one, the scale of economy recovery can be reflected by the rate of the user satisfaction in Mobile Services based on our previous studies. This is particularly true for Euro zone that the economic downturn can trigger customers leaving more expensive Mobile services and opting to the cheaper alternatives.

4.1 OSM metrics and data processing overview

Descriptions for the process and the input datasets are highly similar to Section 3.1 except the measurement was taken place in Spain. Five Spanish cities were chosen for customer satisfaction survey: Madrid, Barcelona, Valencia, Seville and Malaga. The populations in Germany are more than Spain, which explains why surveys in six instead of five cities took place in Germany.

4.2 OSM data analysis

This section presents the results of Spanish data between January and December 2011 in the iPhone 4S Mobile Cloud service. The results for OSM regression is in Table 2 as follows.

Table 2: OSM key statistics for Spanish data in Mobile Cloud analysis

Beta 64.13% of risks: external and 35.87% of risks: internal	0.8132	**Durbin-Watson** Pr>DW (negative autocorrelation: maximum of 1) Positive autocorrelation (p-value)	1.2906 0.9895 0.0105
Standard Error	0.1043	Regress R-Square (99.99 C.I)	0.6413
Mean Square Error (MSE)	0.10527	Regress R-Square (95 C.I)	0.7265

Further explanations are presented as follows.

- Beta is equal to 0.8132. The medium-high value suggests the project risk is maintained at an acceptable control rate but is likely to expose to uncontrolled risk.
- Standard error is 0.1043. The low value suggests most metrics are close to each other and the data has fewer extremes. There is a high consistency between all metrics.
- The first order Durbin-Watson: Results show that there is a high negative auto-correlation (0.9895), which is close to 1 in favor of OSM and also has an acceptable quality of data and standard errors. The p-value is the positive autocorrelation and is equal to 0.0105.
- The low Mean Square Error (MSE) value suggests a good consistency between actual and expected return values.
- Main regression R-square is 0.6413. It means 64.13% of the risks are from the externals such as funders' cost-saving plans and 35.87% of the risks are from the internals, which include higher line rental prices or services not improved over 12 months.

4.3 3D Visualization results for Spanish data

The process and motivation of undertaking 3D Visualization is identical to Section 3.3, except Spanish data is presented this section.

Figure 2 shows the 3D Visualization for iPhone 4S user satisfaction in Spain. The x-axis shows actual iPhone satisfaction rating is between -5.5 to -7.2%, and the y-axis shows expected iPhone satisfaction rating is between -4.3 to -6.0% and z-axis presents risk-control rate in the market is between 1.2 and

1.8%. The EU market has an economic downturn, which is expected to impact sales and popularity, but the actual performance is lower than the expected performance like the German data. This may mean iPhone 4S has tough competitions from Android systems or other systems with cheaper prices [13].

- x-axis: Actual iPhone satisfaction rating (-5.5 to -7.2%)
- y-axis: Expected iPhone satisfaction rating (-4.3 to -6.0%)
- z-axis: Risk-free rate in market (1.2-1.8%)

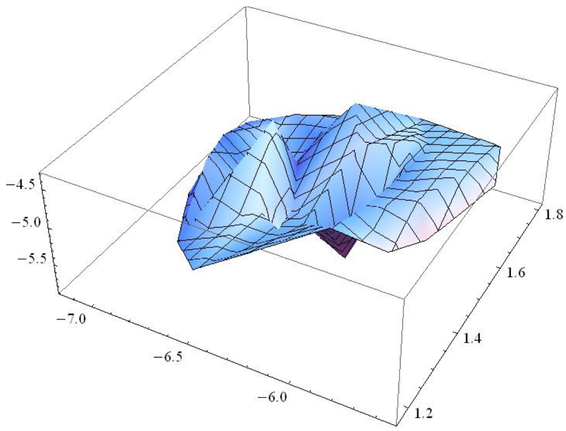

Figure 2: iPhone 4S user satisfaction in Spain between January and December 2011

5 DISCUSSION

This paper presents two topics of discussion. The first topic explains whether our results support the first hypothesis. The second topic describes the use of OSM for Mobile Cloud research with its future direction.

5.1 Results support the first hypothesis

In Section 2.3, we explain the first hypothesis that the rate of customer satisfaction in Mobile Cloud Services can reflect the recovery on economy. Results in both German and Spanish data support this. First, all the actual and expected customer satisfaction ratings went down. The rate of actual satisfaction decline was even more than the expected satisfaction decline. Second, numerous German and Spanish users gave feedback that services were not improved in their last twelve months despite of high monthly rental fees. They provided feedback that the costs of maintaining iPhone 4S with its cloud services were high. As a result, they left for cheaper options which could provide comparable levels of services. The reason that made about 45% of them dissatisfied was due to “not value for money”, about 30% felt “services were not improved” and 25% felt “the costs were too high compared to other similar services”, which was different from the first main factor because those customers expected much more demands and requirements if they were willing to pay more. Third, all the customer satisfaction declines in both Germany and Spain could reflect the economic situations in both countries that they were still in the process of economic recovery and the consumer spending on the high-end products in our quantitative analysis could support in this hypothesis.

5.2 OSM for Mobile Cloud research and the future direction

OSM is the only model developed in academia that has numerous case studies that can analyze the risk and return status for projects with Cloud adoption, including Mobile Cloud Service. Our previous work has presented the case studies for Vodafone/Apple Mobile Cloud strategies in 2009 and iPhone 4S customer satisfaction in Germany between January and December 2011. This paper presents two case studies of analyzing German and Spanish customer satisfaction data between January and December 2011.

Mobile Cloud is a highly competitive area that services need to be constantly improved and prices should be reasonably adjusted [2], [6], [8], [13]. There are other mobile service providers offering Samsung, HTC, Sony and Nokia/Windows services that require further analysis. The iPhone 5S user satisfaction study will also be investigated.

6 CONCLUSION

We present the use of OSM to analyze the popularity in the Mobile Cloud. We use the German and Spanish data between 2011 and 2012 as the example and compare the actual values, expected values and risk-control rates in all the datasets. We explain the use of OSM to process datasets and the key statistics involved and their interpretations. We explain all the key results and show that there is a decline in the popularity due to the economic downturn and also competitions from other mobile systems.

Key results include the beta, standard error, Durbin-Watson, p-values, mean square errors and R-squared values. We confirm that all these key figures fulfill the criteria for the OSM analysis. The use of 3D Visualization can expose unexploited data analysis and also ensure the stakeholders can interpret analysis easily. OSM is an innovative approach which can be adapted in other research projects, in different disciplines and in other case studies. We demonstrate how to use OSM to analyze Mobile Cloud customer satisfaction. We set a hypothesis and explain how results of German and Spanish data support our hypothesis. The direct feedback from those German and Spanish customers also provided useful information for the potential investors in understanding more about the situations of the Mobile Cloud service in the European zone. We will illustrate how OSM can be used in other disciplines and also other European countries to study the popularity in the use of Mobile Cloud.

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Dr. Victor Chang has been a technical lead in web applications, web services, database, grid, cloud, storage, bioinformatics, research and financial modeling. He has delivered many IT projects in Taiwan, Singapore, Australia, and the UK since 1998. He is experienced in a number of different IT subjects and has 27 certifications with 97% on average. He completed PGCert (Higher education) and PhD within four years part-time while working full-time, whereby the distance between his work and research is hundred of miles away.

Victor is a winner in 2011 European Identity Award in On Premise to Cloud Migration. He was selected to present his research in the House of Commons, UK, in 2011. He demonstrated numerous Cloud services in both of his practitioner and academic experience. He has 27 publications in the last four years as the first author.